ANIMAL LIFE IN THE GULF STREAM.

By RALPH S. TARR.

IN the Gulf Stream, near the surface, animal life is extremely abundant, both young and adult finding the warm waters of the current peculiarly adapted for life and rapid growth. Cuttle-fish swim about, chased by sword-fish, dolphins, and sharks. Attracted by the glare of the electric lights in the evening, large schools sport around the United States Fish Commission steamer Albatross, swimming backward and forward with equal facility, leaping out of water and ejecting their black, inky fluid whenever surprised. Many devices were tried for the capture of one of these quick-motioned creatures, but we failed to secure any until an ingenious sailor rigged a peculiar spear, which, when properly used, would bring the cuttle-fish on board. This curious animal, classed by naturalists among the mollusks, or shell-fish, has so little resemblance to its relatives, oysters and clams, that an average observer would be far more likely to place it among the true fishes. It has large, prominent eyes, and its mouth is armed with a horny beak, very much like a parrot's bill. With this it undoubtedly proves itself a dangerous enemy to many marine animals. Forward motion is obtained by a fin-like tail, while it moves backward by suddenly forcing water out of a bag having its opening near the creature's mouth. Ten arms or feelers, with their inner surfaces lined with suckers, are arranged about the mouth. Although it seldom grows over a foot long, an embrace from its arms is painful. How much more so must it be in the case of the large octopus, or devil-fish, of the North, which is often forty feet in length, measured from the tips of the two long arms! In this latter animal the suckers are sometimes two inches in diameter, and, when worked by the powerful muscles, painful wounds can be produced. From earliest times fabulous accounts of a creature like this have been circulated,

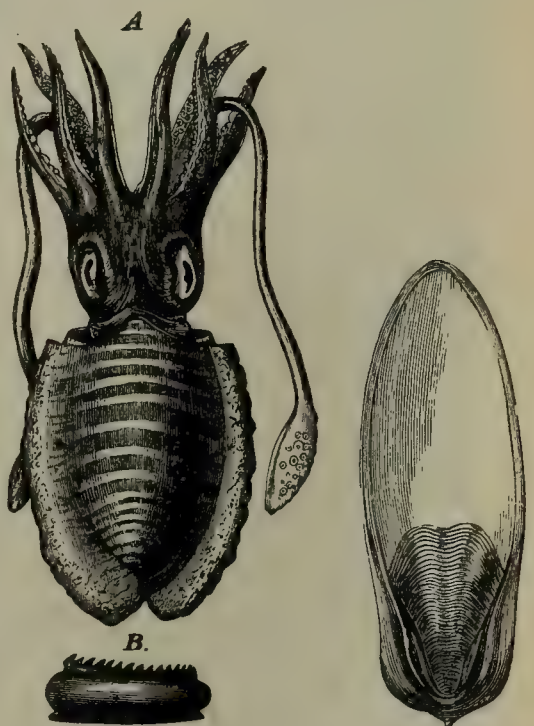

FIG. 1.—CUTTLE-FISH (*Sepia officinalis*) AND SHELL.

but it was not until 1870 that this animal was accurately studied and described by responsible persons. Previous to that time it was regarded with the same skepticism that the sea-serpent now

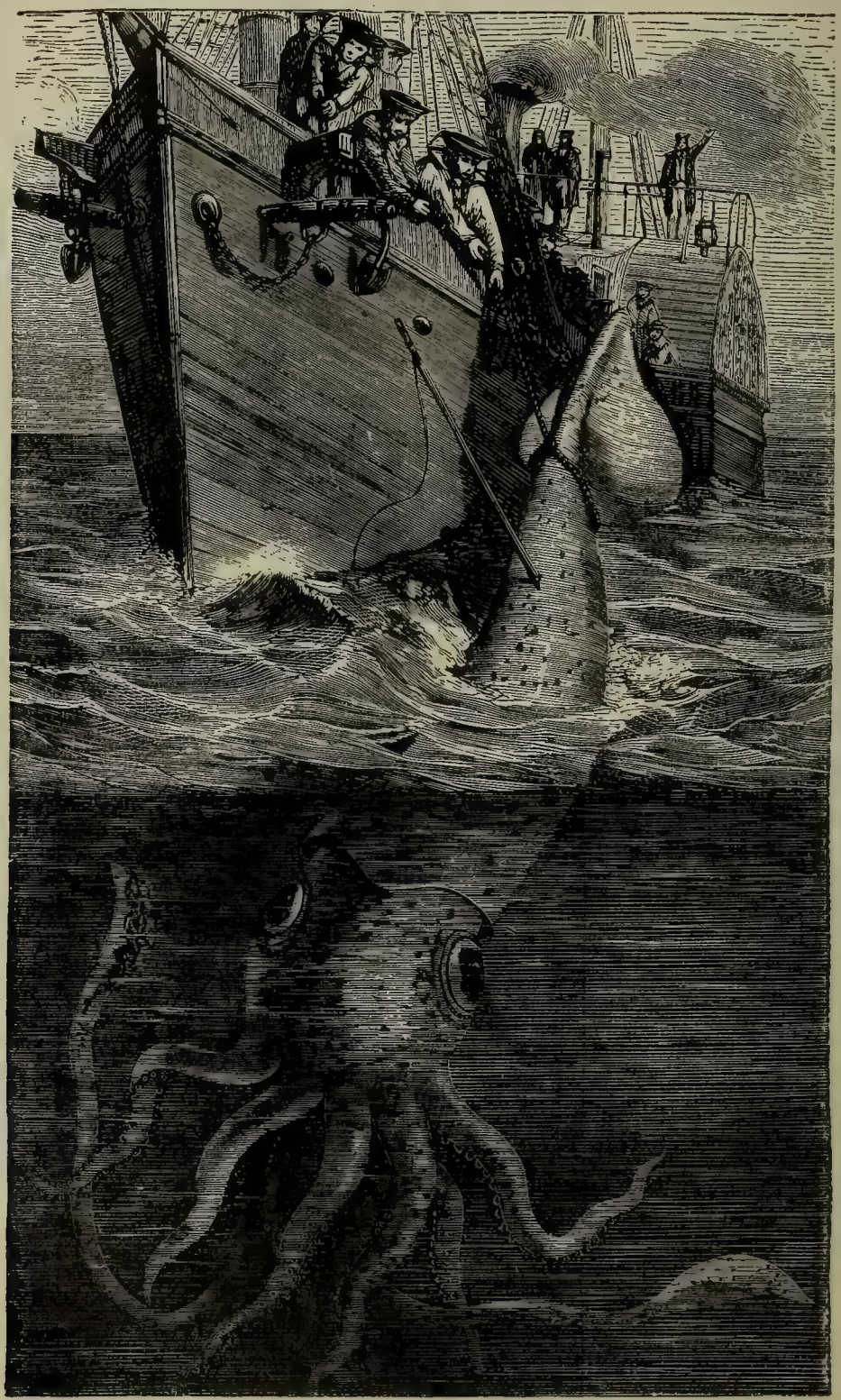

FIG. 2.—CAPTURE OF A GIANT SQUID.

is by many. However, naturalists are beginning to look upon the sea-serpent theory with more favor, while a few are active

supporters of the belief that the sea is still possessed of some descendants of the enormous fish-like reptiles which inhabited it in early geological periods. A fair picture but poor description of an octopus is given by Victor Hugo in his "Toilers of the Sea." He, in the course of his description, becomes very much confused, mixing devil-fish with polyp, and describing an animal possessed of habits belonging to each of these two widely separated groups. The confusion apparently arises from the fact that a common name for the octopus is *poulp*, but this etymological resemblance to the polyp, or sea-anemone, is the only one. He also confounds the name *Cephalopoda* with *Cephaloptera*, a gigantic ray or skate, also called devil-fish, and this causes new confusion in the description. There are gigantic octopi in the Southern waters, and these furnish food for the toothed sperm whale. Our Northern devil-fish is not a true octopus, but a squid, for it has ten arms instead of eight.

A sword-fish captured during the voyage was found to have in its stomach over thirty eyes and twenty beaks of the small cuttle-fish, together with a few partly digested individuals. Sword-fishes and sharks are natural enemies, always fighting when they meet, and there are accounts of fierce and deadly encounters between them. An ugly sword-fish is a bad enemy to encounter, using its weapon, as it does, with such ease and force. One will often drive its sword through the bottom of a boat, and, if it succeeds in withdrawing it without breaking it off, the boat rapidly fills with water, and the occupants, driven into the sea, are savagely attacked and badly wounded by the furious fish. At times they are abundant on all sides, lying near the surface, with their dorsal fin projecting above.

A sailor speared a dolphin one day, much to our surprise, for they seldom came near enough to reach. For several days there had been a school around, probably attracted by the refuse thrown overboard, by the brilliant light at night, and by the cuttle-fish which kept near the vessel. They usually remained many feet below the surface, and, viewed through the deep azure-blue water of the Gulf Stream, the different colors of their bodies reflected in the sunlight, and again in the electric light, were beautiful in an extreme degree. At last one, coming too near the surface, received a fatal wound, and was successfully brought on deck. I had often heard of the changing colors of a dying dolphin, and now I was to witness them for the first time. No one can exaggerate the weird beauty of the sight as the fish in its last struggles changes through all its various hues. One can see the colors disappear, to be followed by others. Beginning with the head, they seem to sweep as a wave over the body. Blue gives place to white, then a light yellow, which in turn changes to a

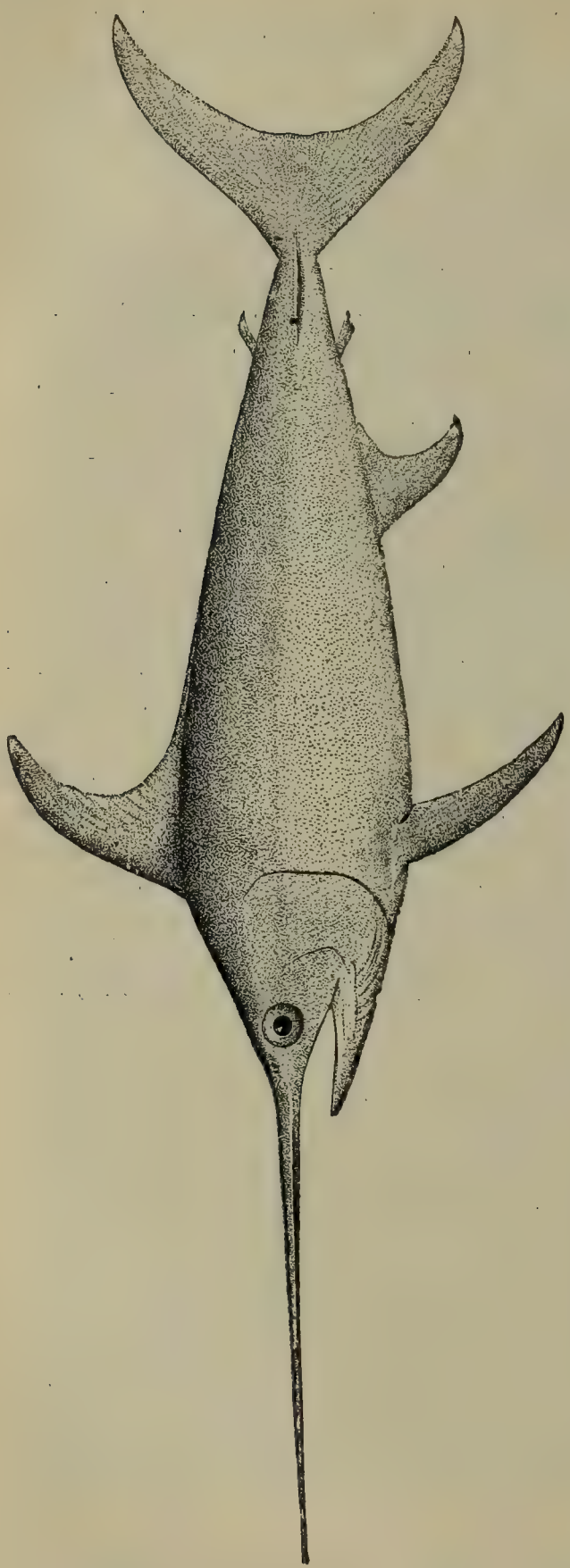

FIG. 3.—THE SWORD-FISH (*Xiphias gladius*).

golden, and following this a copper-colored tint; and so on through all conceivable hues, until finally, the end having come, change is interrupted in its course, and two tints are left in possession of the body—one in the act of disappearing, the other about to spread itself over the surface. That portion exposed to sunlight changes more rapidly, while the under side is less gorgeous. Here we see a peculiar property possessed by many animals widely separated in the scale of life—that of changing color at will, either to suit the surrounding shade, as illustrated in the chameleon and dolphin, or to attract certain kinds of prey, as seen in many of the lower marine animals—which becomes so much a habit in the case under consideration that, even when death is at hand, the changes are all passed through involuntarily.

Stormy petrels, or Mother Carey's chickens, as they are more commonly called, follow the outbound vessel in large flocks, gathering about as soon as land is lost to view, and remaining until the shore is once more sighted, unless a violent storm drives them

away. For the most part they feed upon refuse thrown overboard, but are never fat and always hungry, due undoubtedly to the fact that they are almost continually upon the wing, seldom being

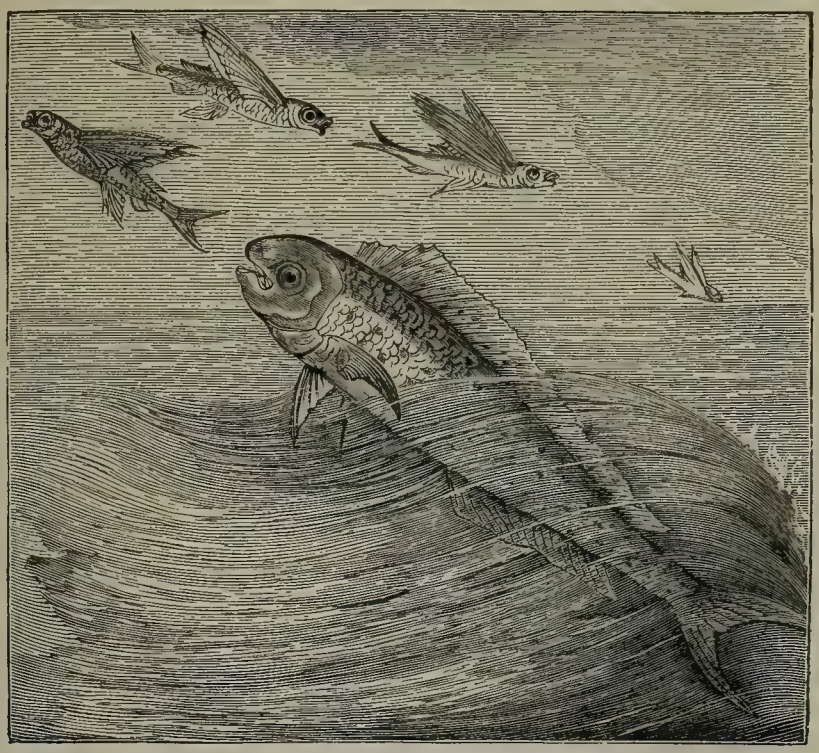

FIG. 4.—FLYING-FISH (*Exocœtus*) PURSUED BY THE DOLPHIN.

seen resting. Hovering over the food in a peculiar manner, by patting the water with its webbed feet and quickly flapping its wings, it appears to stand on the water, and, following the food as it is drifted about, to walk along. Sailors regard it with great superstition, and believe that some calamity will follow the wanton killing of this bird. They seem to have no fear of man, for they constantly flew near and aboard the vessel. Attracted by the lights, many flew aboard at night, and, striking the house, fell senseless to the deck. These birds must have a very short and irregular breeding period, for they are found several hundred miles from land, at all seasons of the year. They probably go in flocks, at different times, to their favorite breeding-place, and after a short period, having raised one brood, they return.

FIG. 5.—STORMY PETREL (*Thalassidroma pelagica*).

Physalia, the Portuguese man-of-war, with its beautiful blue float, may at times be seen on all sides. The float, filled with air, serves to keep the animal on the surface, and, driven by the wind, to bear it from place to place. It is a curious animal, or rather cluster of animals we should say, for naturalists now consider it to be a group of individuals, having different functions, but working for the same general cause—that of supporting the mass. They say that in this group there are some whose sole purpose is to obtain food, some to digest, others to reproduce, etc., yet each is an individual animal working for the good of the whole, that the whole may work for its good, and that in conjunction they may perform all the functions of life necessary to the well-being and general welfare of the whole united colony. The cluster has most remarkable defensive powers, being well furnished with lasso cells or stinging organs. These consist of little barbed, arrow-like points, fastened to thread-like arms, each of which is coiled up in a little cell. Whenever it is necessary to use them they are hurled out with violence, and each barb, striking the object, penetrates, for it has the power of "working into" flesh, and, being covered with a sort of poison, it in conjunction with many others benumbs the prey and renders it harmless. That the *Physalia* possesses this property to a marked degree, some of the sailors of the Albatross can testify, for they incautiously placed their hands in a tub of water containing one, and the shock they received was compared in violence to a strong shock from a Leyden jar. Sea-anemones possess this same property, although the common shore species can affect only very tender animals. I have seen a deep-sea anemone, six inches in length, by this means kill and afterward swallow a lively fish a foot long, that was placed in the aquarium with it. The fish barely touched the anemone, then seemed incapable of moving farther, and after a few struggles became paralyzed. These arrow-points possess the power of motion for several hours after being detached from the animal. Lasso cells can be replaced when lost, and in a very short time. On a square foot there are millions of cells. It is a curious fact that all well-defended animals

FIG. 6.—PORTUGUESE MAN-OF-WAR (*Physalia arethusa*).

—I speak with particular reference to the lower marine animals—are usually brilliantly colored. This can be seen in the case of sea-anemones, tropical shells, and crabs. Those with little or no defense are inconspicuous and resemble surrounding objects. The reason for all this is plain, for if inconspicuous they easily escape the notice of their enemies. Brilliant, well-defended animals have little fear of enemies, but by their bright colors will attract curious animals within reach of their deadly powers.

Like the *Physalia* in general structure, and in the fact that they possess stinging cells, are the jelly-fishes, which are present in the Gulf Stream in a great abundance of forms. There are

FIG. 7.—A JELLY-FISH SWIMMING.

bell-shaped, tubular, spherical, discoidal, and many other forms, most being transparent, but some very brilliantly colored. One of the disk-like forms is colored with deep purple and orange bands radiating from the center, while from the entire circumference hang many transparent tentacles. The mouth of most jelly-fishes is beneath, in the center of the bell, and is surrounded by tentacles which procure food. These are also furnished with stinging cells by which the food is killed. Their modes of repro-

duction are curious. In some a portion of the body of the parent begins to grow out, and this continues until a perfect bud-like protuberance is the result, and then the bud drops off and, after various interesting changes, becomes a fully formed jelly-fish. Sometimes the parent begins to divide, and actually splits into two parts, each of which becomes a perfect animal.

So great is the transparency of most jelly-fishes that they are scarcely visible; but at night, what a change takes place! When a school is passed, the water becomes suddenly transformed to a mass of liquid fire, composed of individual balls that together, on account of their great number, appear as one vast sheet of light. When they are disturbed, their brilliancy is increased. Far different from the jelly-fish in structure, but resembling it in its phosphorescence, is *Pyrosoma,* a colony of animals often found in these warm waters, which together form a fleshy mass, possessing no remarkable points by day, but at night becoming most brilliantly phosphorescent. In the mass, six inches in length, there are hundreds of separate animals, each like the others, all massed together in a common colony. They are very curious, for, while most of the young remain to help build the mother colony, some become entirely separate, and, after swimming about for a while, begin a new cluster that soon takes the form of the parent group. Each group has a regular shape just like the original one. The same is true of corals and most other clusters formed of more than one individual.

In our surface towings we find many beautiful animals, but none have impressed me so strongly as the so-called sea-butterflies. They are small, usually, and seldom found in abundance, and, being thus inconspicuous, are not likely to be seen by those not specially searching for them. Every color is found in these beautiful forms, and, as they float upon the surface, with their wing-like expansions spread out to catch the wind, but a small amount of imagination is needed to transform them into true butterflies accidentally fallen into the water. They have a very light and beautiful shell, with an air-chamber above to serve as a float, while from a lower compartment the wings are expanded. When startled, their sails are withdrawn into this chamber, and the oddly shaped shell is alone exposed to view. Sea-butterflies can, by arranging their sails so as to utilize the wind in the most effective manner, guide their course to a certain extent, just as the ship can proceed against a head wind. Their shells, which are often taken without the animal, present many very peculiar forms, from the nearly round to the long, sharply pointed ones, some with spines, others perfectly smooth; and we can see them in every conceivable color, the glassy, transparent kinds, the milk-white, and masses of the most brilliant colors, so confusing

and varied as to defy all comparison or description. These little animals, living in the water and moving from place to place, are as perfect and sea-worthy ships in miniature as the best modern vessels, and built upon as improved a pattern as our vessels which have been so long evolving. They have for centuries plowed the open seas in their vessels, never seeking port and never suffering disaster. With their air-float above, in addition to buoyancy, perfect stability is obtained. Their body below serves as ballast, and their membranous wings are good sails, that can be furled or hoisted at the animal's will. No masts to be carried away, no anchor needed, but perfect safety always. How well adapted for their surroundings—indeed, how well all Nature's creatures are adapted for their mode of life! How many ideas in modern architecture and engineering, but just discovered as the result of long study and experiment, have been in use for centuries untold among the lower animals which we are so wont to regard as unworthy of life! The ant, the bee, the spider, and hundreds of others are to-day using principles which man has yet to learn. The properties of the arch and dome, if not first learned from animals, might have been, much to man's advantage, long before he discovered them.

On very rare occasions the nautilus is found, and at times we also fall in with the *Argonauta*, or paper nautilus. They are both related to cuttle-fishes, differing from them in having shelly coverings and in some other more technical points. Each has a row of arms, with suckers around the mouth, and they move in the same manner as true cuttle-fishes do—by ejecting a quantity of water through a tube with such force as to drive the animal backward. The nautilus, as it grows, builds the shell larger to accommodate the growing body, building on the edge and continuing the spiral, and at the same time forming a partition across the rear. If a nautilus-shell is cut longitudinally, it will be found to be made up of a large anterior chamber, which the animal occupied just before it died, and behind a large number of chambers separated from each other by transverse partitions, and connected together only by a small circular hole that exists in each partition. When the nautilus is alive, a fleshy tube runs through all these chambers, passing through the holes, and forms the only connection between the animal and the rear chambers once inhabited by it. It is thought that by means of this tube the rear compartments can be filled with water or emptied at the animal's will, thus allowing it either to rise to the surface or to sink to any required depth. *Argonauta* is a pure white, ridged shell, thin and delicate, the animal being very much like the nautilus; but in this case the female alone has the covering, while the male is entirely without a shell. In many cases, among the lower forms of ani-

mal life, the male is unprotected, while the female is covered by some very perfect shell, or is otherwise well fitted for self-protection, all undoubtedly for the preservation of the young. The higher we ascend in the animal kingdom the more we see the opposite extreme, the male being the best fitted to defend, and hence assuming both its own protection and that of the weaker sex. Far back in remote geological periods animals resembling

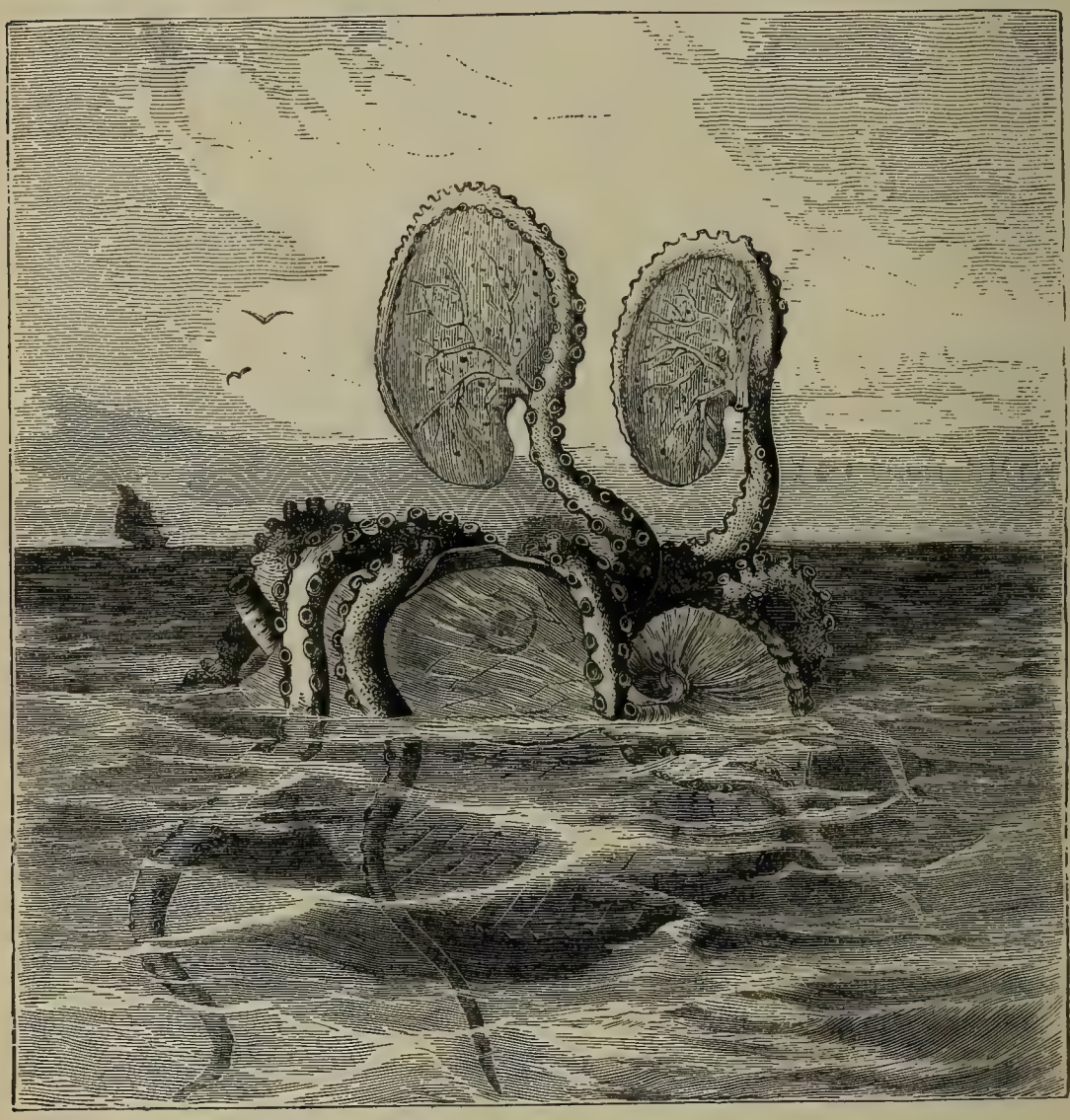

FIG. 8.—THE ARGONAUT.

the nautilus and *Argonauta* were extremely abundant, and also forms even more primitive than these; but to-day we have only a very few as representatives of this large group of fossil animals.

The surface-waters in the Gulf Stream teem with minute life of all kinds. There the young of larger animals exist, microscopic in size; and adult animals which never grow large enough to be plainly visible to the naked eye occur in immense quantities. By dragging a fine silk net behind the vessel, these minute forms are easily taken, and when placed in glass dishes millions uncount-

ed are seen swimming backward and forward. When looked at through a microscope we see young jelly-fishes, the young of barnacles, crabs, and shrimps, besides the adult microscopic species, which are very abundant. The toothless whale finds in these his only food. Rushing through the water, with mouth wide open, by means of his whalebone strainers the minute forms are separated from the water. Swallowing those obtained after a short period of straining, he repeats the operation. The abundance of this kind of life can be judged from the fact that nearly all kinds of whales exist exclusively upon these animals, most of them so small that they are not noticed on the surface. Prominent among the animals obtained from the surface towings is *Sapharina*, a small crustacean which is remarkably iridescent, flashing in the sunlight with metallic colors. It darts swiftly about, now green, now blue, and very conspicuous on account of its ever-changing hues. Another similar form is red. At all times, and in nearly all places, both in the Gulf Stream and in the warmer waters outside, there is an interesting transparent animal called *Salpa*. At first glance it would appear to be structureless, but, if carefully studied, a mouth, a stomach, and other organs will be found, which place it among the higher invertebrate animals. They swim around in large schools, but on account of their great transparency are scarcely visible. Whether or not they serve as food for other animals I do not know, but it seems that a meal made of them would be rather unsatisfactory on account of the great quantity of salt water that enters into their construction. They often have a curious blue parasite inside the body walls, and this is about the only visible sign of structure. Very few animals are free from parasites, and in the fishes they are numerous, burrowing into the gills, in the roof of the mouth, and all over the external portions of the body. On sharks we sometimes find them four inches long, an inch of which extends into the flesh. There is one called *Penella*, which is very long, and has a hairy tuft on the outer end. In most cases this parasite has attached to the external stem a species of barnacle, which itself has small parasites. Parasitic tendencies degenerate an animal, so that many of the once essential organs become useless and are lost. We see this well illustrated in *Penella*, which is an ally to the shrimp, but has so changed, by losing its feet and other organs, as to bear but little resemblance to these higher crustaceans. Degeneration is still

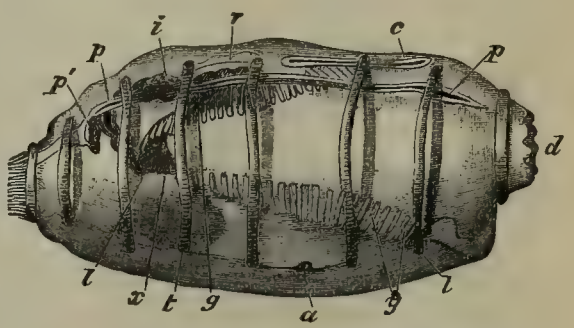

FIG. 9.—DOLIOLUM (AN ASCIDIAN ALLIED TO THE SALPA).

better illustrated by certain worm-like animals which live in the stomachs of sharks and other fishes. Being placed where food is ground up fine and all ready for assimilation, there is no need of a mouth, and but little need of a stomach, so both of these organs are lost, and all food is absorbed into the system through the outer walls of the body. Eyes are also lost, and the animal becomes a mere stomach; but, as for that matter, most animals are a mere stomach, with a few necessary organs to assist it. Some true fishes can be classed as parasites, while many use other animals as a means of attachment and protection. Under the dome of the true bell-shaped jelly-fish, a species of fish is generally found that is never taken under other conditions. It appears not to be affected by the stinging cells of the animal, but will stay near the mouth while the darts are exerting their deadly powers upon some brother-fish, and after this fish is dead will pick up enough for a meal from what the jelly-fish does not eat. What benefit this fish is to the jelly-fish it would be impossible to say, but in such cases some service is usually returned, such, for example, as that of warning the friend in case of danger. This habit of commensalism, or eating at the same table, is seen in other animals, as the oyster-crab, pilot-fish, and others. They seem to recognize their friends, and not only do not harm but even protect them. The oyster-crab could, if so inclined, devour the oyster without trouble, but it never offers to. Under such conditions certain apparently deadly powers have no effect, and these animals may even be entirely unharmed by digestive fluids. Fish are sometimes found in very odd places. One burrows into the side of a larger fish and stays there, as in a house, catching what food passes by. Another fastens itself on to the sides of a fish by means of a sucker, and, assuming a similar color to that of the larger one, is easily overlooked by its enemies. One of these, the lump-fish, is a very pretty green in color. There are certain fishes that always stay in the surf near shore, being able to remain there without being cast ashore, and never seeking quiet water.

Among the patches of sea-weed which float in the Gulf Stream there are numerous small fishes very prettily colored. One among these has a curious mode of defense, and because of this is called the file-fish. Normally folded down upon its back is a rather long spine. Whenever danger is apprehended, this spine suddenly springs upright, and is held there by a little bone behind it near the base and under the skin. If this bone is touched with a knife, it can be pressed down, and then the spine will fold back; but, unless the bone is removed, the spine will remain rigidly upright. The fish possesses the power of raising or lowering the spine at will. We sometimes see flying-fish jump out of the water and scale along the surface for many feet. Chased by their enemies,

they seek safety in the air, and, after darting as far as possible, will strike the water again and then dash off in another direction. They present a very odd appearance, skipping out of the water and passing through the air by means of their wing-like fins, and then again disappearing. While trying to escape their finny enemies they often fly right into the claws of an albatross or some other large sea-bird, jumping, so to speak, "from the frying-pan into the fire." A hard lot is theirs in this struggle for existence, eating smaller animals only to be themselves eaten. The panic which a shark will cause in a school of mackerel or menhaden, or a dolphin among flying-fish, can hardly be described. Another curious fish that we sometimes meet with is the *Hippocampus*, or sea-horse. These little creatures are most interesting to watch in an aquarium. They curl their tails about any object which will hold them in place, and then assume an upright position. With their peculiarly shaped head and large, intelligent eyes, an almost perfect miniature resemblance to a horse is plainly seen. There

FIG. 10.—SEA-HORSE (*Hippocampus brevirostris*).

FIG. 11.—GOOSE BARNACLES ON A BOTTLE.

it sits motionless, rolling its prominent eyes backward and forward until a small animal comes too near, when a sudden dive is made, which generally ends fatally to the intended prey, and then the same grave indifference is assumed. Altogether it reminds me of a toad watching for its food.

Floating around on all sides are numerous patches of gulf-weed filled with life of all kinds. Here good-sized crabs and shrimps flee for refuge from larger foes, and feed upon their more minute brethren also seeking safety under the floating weed. Here the goose barnacle is found in great numbers attached to everything that floats. This is the animal which is such an enemy to shipmasters sailing from tropical ports. Although the vessel's

bottom is scraped just before leaving port, young goose barnacles attach themselves in such numbers that, owing to their rapid growth, they seriously retard the ship's progress. There is no remedy but to sail on, letting them grow as fast as they will, and removing them when port is reached. Norwegian sailors believe that the barnacle goose hatches out of the goose barnacle, and many have asserted that they have seen the young just on the point of flying out. This belief probably arises from the peculiar scooping motion of the fringed feet of the barnacle while it is obtaining food. Even then a good imagination needs some stretching to be able to see a resemblance to a young bird. When a barnacle is young, it is free-swimming, and resembles a shrimp; but, as it grows older, it attaches itself to some object by a sort of cement, and becomes so changed that, unless its anatomy is carefully studied, no affinities to a shrimp would be imagined. Indeed, early naturalists considered it to be a shell-fish or mollusk. Odd as it may seem, many kinds of animals, at first possessed of free motion, voluntarily attach themselves to some object, and are from that moment imprisoned, having no power of moving from place to place.

Insects are seldom seen in a natural state far from land, but we find a few young forms a little nearer shore, and one of these, a fly larva (*Chironomus*), is more interesting than the others on account of its remarkable powers of endurance. Experiments were tried, and we found that it would live after being taken out of a vial of alcohol in which it had been kept several hours. Most animals, under similar conditions, will die in five minutes, and the most hardy in twenty. Different poisons were tried, and none were effective. Even caustic potash was resisted for nearly an hour. In the mean time the creature would swim around lively. Such hardiness is probably found in no other animal. In addition to these more interesting forms, there are hundreds of species each presenting some especial peculiarity which distinguishes it from the rest, and all have interesting habits and points of structure. The waters of the Gulf Stream gradually merge into those of the ocean on either side, and, while there are some peculiarly tropical forms which never go outside of the warm water, most are likely to be taken on either side in the colder waters, and there are many which are found both near shore and in the Gulf Stream. After long-continued southerly winds, tropical forms are at times cast on shore; and vessels passing through the Gulf Stream frequently bring into port, attached to their bottoms, crabs and shrimps which normally do not live in the inner region. The warm waters of this part of the ocean are very favorable to rapid growth, and the animals there are tropical. Washing the shores of Florida, the Gulf Stream serves to transport its

animals to Europe, and the many kinds which we have been considering are thus carried from place to place without their own guidance. Thus it is that the tropical faunæ of the two sides of the Atlantic so closely resemble each other. The Gulf Stream, then, serves not only to modify the climate of naturally cold regions, but also to distribute life equally on two different shores, which, without some such communication, would have animals as decidedly different as are those of Asia from American east coast species.

HUXLEY AND PASTEUR ON THE PREVENTION OF HYDROPHOBIA.

AT the call of the Lord Mayor, a meeting was held at the Mansion House, in London, on the 1st of July, to hear statements from men of science with regard to the recent increase of rabies in England and the efficacy of the treatment discovered by M. Pasteur for the prevention of hydrophobia. Among several letters that were read, the following, one from Prof. Huxley and the other from M. Pasteur himself, are of especial interest:

"MONTE GENERASO, SWITZERLAND, *June 25, 1889.*

"MY LORD MAYOR: I greatly regret my inability to be present at the meeting which is to be held under your lordship's auspices in reference to M. Pasteur and his institute. The unremitting labors of that eminent Frenchman during the last half-century have yielded rich harvests of new truths, and are models of exact and refined research. As such they deserve and have received all the honors which those who are the best judges of their purely scientific merits are able to bestow. But it so happens that these subtle and patient searchings out of the ways of the infinitely little—of that swarming life where the creature that measures one thousandth part of an inch is a giant—have also yielded results of supreme practical importance. The path of M. Pasteur's investigations is strewed with gifts of vast monetary value to the silk-trader, the brewer, and the wine merchant. And, this being so, it might well be a proper and a graceful act on the part of the representatives of trade and commerce in its greatest center to make some public recognition of M. Pasteur's services even if there were nothing further to be said about them. But there is much more to be said. M. Pasteur's direct and indirect contributions to our knowledge of the causes of diseased states, and of the means of preventing their occurrence, are not measurable by money values, but by those of healthy life and diminished suffering to men. Medicine, surgery, and hygiene have all been pow-